

# Nomadic Exploration: Following routes of solar sustenance and temperate climate

Completed Technology Project (2013 - 2015)

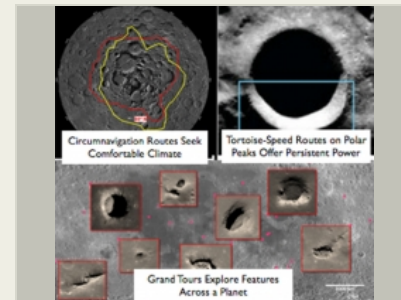


## Project Introduction

Conceptual existence of circumnavigation routes was speculated in the proposing team's Phase I NIAC research, but at that time terrain model resolution was too low to enable accurate route-finding, and fidelity of terrain knowledge was too low for validation of route existence. The Lunar Reconnaissance Orbiter (LRO), Mars Reconnaissance Orbiter (MRO), and Messenger missions have changed that fact: detailed surface maps now exist for the Moon, Mars, Mercury, and some asteroids, and the time is right for a great leap of viability for the visionary concept of Nomadic Exploration. The proposed research will discover and characterize the first Nomadic Routes to encircle planets, dwell at peaks, and circumnavigate asteroids. Research thrusts in sensing and planning technologies for rover energetics, speed, and autonomy will make the great leaps necessary for Nomadic expeditions like equatorial circumnavigation. Magellan Routes on the Moon will be discovered by applying resource-aware planning methodology to terrain, solar, and thermal data acquired in recent missions. These concepts will be extended to asteroids with slow orbital periods that might allow for sun following in very low gravity and for seasonal polar missions to Mars. Demonstration of critical concepts will occur in simulated and physical test-beds tuned to emulate the parameters of terrain, illumination, temperature and gravity essential for these missions.

## Anticipated Benefits

The discovery of temperate, sun-lit routes enables a fundamentally improved means of exploring a planetary body: long-term, non-stop surface missions. Nomadic rovers are cold-blooded, energy gathering, resource-aware agents that will pioneer and exploit routes of continual light and temperate climate. Once established, such routes will be the bases for science, human presence, circumferential utilities on favored features, and planetary circumnavigators akin to Magellan. The proposed research will discover and characterize the first Nomadic Routes to encircle planets, dwell at peaks, and circumnavigate asteroids.



Project Image Nomadic Exploration: Following routes of solar sustenance and temperate climate

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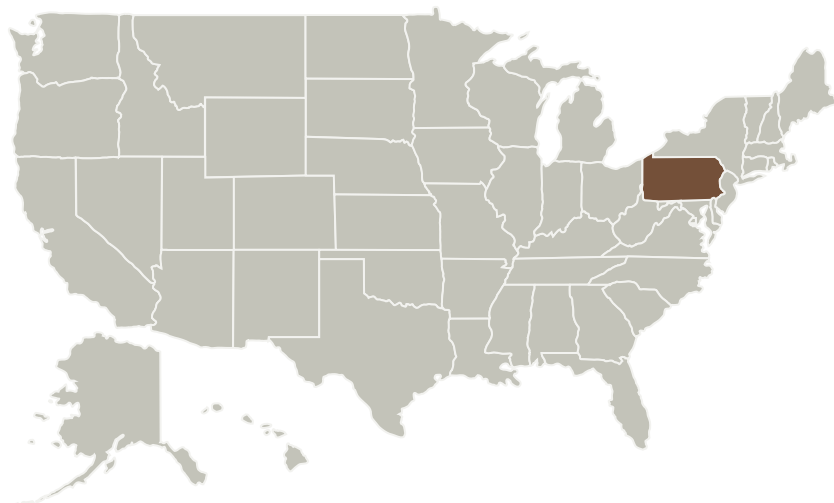
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## Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
Carnegie Mellon University	Lead Organization	Academia	Pittsburgh, Pennsylvania
Astrobotic Technology, Inc.	Supporting Organization	Industry	Pittsburgh, Pennsylvania

## Primary U.S. Work Locations

Pennsylvania

## Project Transitions

 **September 2013:** Project Start **September 2015:** Closed out  
**Closeout Summary:** 1 patent

## Organizational Responsibility

**Responsible Mission Directorate:**

Space Technology Mission Directorate (STMD)

**Lead Organization:**

Carnegie Mellon University

**Responsible Program:**

NASA Innovative Advanced Concepts

## Project Management

**Program Director:**

Jason E Derleth

**Program Manager:**

Eric A Eberly

**Principal Investigator:**

David Wettergreen

**Co-Investigator:**

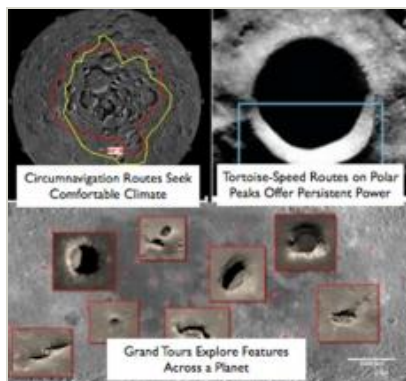
Kevin Peterson

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## Images



**13752-1390594205486.jpg**

Project Image Nomadic Exploration: Following routes of solar sustenance and temperate climate

(<https://techport.nasa.gov/image/102288>)

## Links

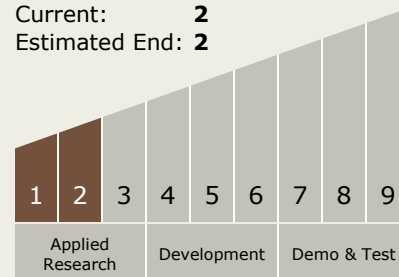
Planetary Circumnavigation  
(<http://www.niac.usra.edu/studies/785Wettergreen.html>)

## Project Website:

<https://www.nasa.gov/directorates/spacetech/home/index.html>

## Technology Maturity (TRL)

Start: **1**  
Current: **2**  
Estimated End: **2**



## Technology Areas

### Primary:

- TX09 Entry, Descent, and Landing
  - └ TX09.4 Vehicle Systems
    - └ TX09.4.5 Modeling and Simulation for EDL

## Target Destination

Others Inside the Solar System